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REGULAR ARTICLE

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Using a peer mentorship approach improved the use of neonatal continuous positive airway pressure and related outcomes in Malawi

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Abstract

Aim: This study evaluated whether peer mentorship was an effective and sustainable way of improving and maintaining knowledge and skills on neonatal continuous positive airway pressure (CPAP) in a low-resource setting with a high turnover of healthcare providers.

Methods: The Malawi Ministry of Health recruited five nurses with considerable CPAP experience and provided them with mentorship training from July to August 2014. The mentors then provided 1-week on-site mentorship for 113 colleagues at 10 secondary and one tertiary hospital where gaps in neonatal CPAP use had been identified. CPAP competencies and outcomes were compared 3 months before and after each mentorship.

Results: In the 3 months before and after mentorship, the average CPAP competency score increased from 32 ± 4% to 97 ± 2%, while CPAP usage increased from 7% to 23% among eligible neonates. Survival following CPAP mentorship increased from 23% to 35%, but this was not significant due to the small sample size. Both mentees and mentors reported useful transfers of knowledge and skills when using CPAP.

Conclusion: Mentorship effectively bridged the knowledge and skills gaps among health workers and increased CPAP use, competency scores and survival rates.

KEYWORDS

continuous positive airway pressure, low-resource country, mentorship, neonatal care, respiratory distress

1 | INTRODUCTION

An increasing amount of affordable, effective and durable technology is available to address health challenges in low-income and middle-income countries.[1] Sustaining the optimal use of such technology requires more than simply installing equipment and providing one-time training to users. Sustainability is often hindered by gaps in infrastructure and policy, especially in resource-constrained health systems. In many cases, sustaining low-cost technical solutions requires adjustments to current personnel, budgets and protocols.[2]

There is a particular need to strengthen technology and systems for the care of newborn infants in low-resource settings. Despite the gains made to reduce global child mortality, neonatal deaths account for 45% of deaths under the age of five and affordable innovation can improve the survival rates of newborn infants.[3] To address this need, a low-cost bubble continuous positive airway pressure (CPAP) device, the Pumani CPAP (Hadleigh

Abbreviations: CPAP, Continuous positive airway pressure; RDS, Respiratory distress syndrome.

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Health Technologies), was evaluated at a central teaching hospital in Malawi. This resulted in a 27% absolute increase in survival among neonates with respiratory distress.[4] The implementation of CPAP was then rolled out to 27 other Government hospitals in Malawi from 2013 to 2016. The initial implementation plan included installation, user training and data collection to monitor patient outcomes. The 8-hour user training programme involved both theoretical and hands-on training to identify suitable patients, put them on CPAP, monitor and then wean them off CPAP. However, high staff turnover, due to attrition and frequent staff rotations on wards, negatively affected CPAP usage and outcomes. This reduced the impact of these costly, time-intensive training programmes. Recognising that re-training the traditional way would take staff away from often understaffed units without providing adequate time for critical hands-on learning, an on-site week-long mentorship programme was implemented at 15 government hospitals across the country. The purpose of this mentorship approach was to encourage learning in a natural work environment. It aimed to address the observed knowledge and skill gaps among both new staff and among existing staff who may have previously received the initial user training offered by the programme.

Evidence shows that mentorship improves the effectiveness and sustainability of health interventions in low-income and middle-income countries.[5,6] Where mentorship has been conducted in a supportive framework, it has been shown to encourage staff to engage in identifying and addressing problems to improve outcomes at their healthcare facility.[7-10] The collaborative nature of mentorship has the potential to increase health providers' knowledge, skills and confidence.[6]

This study examined the effectiveness of the CPAP mentorship programme by analysing changes in the staff's CPAP knowledge and skills, CPAP usage and the survival rates for neonates treated with CPAP before and after mentorship.

Key Notes

- This study evaluated whether using specially trained nurses to mentor peers in Malawi improved the knowledge and delivery of neonatal continuous positive airway pressure (CPAP).
- The five nurse mentors were trained centrally and provided on-site mentorship for 113 colleagues at 11 hospitals where gaps in neonatal CPAP had been identified.
- Mentorship effectively bridged the knowledge and skills gaps among health workers and increased CPAP use, competency scores and survival rates.

2 | METHODS

2.1 | Mentorship structure

We selected seven nurses, who showed expertise, commitment and enthusiasm during CPAP implementation at their hospitals, to become mentors as part of a Ministry of Health quality improvement initiative. These mentors were oriented on the use of mentorship tools developed by clinicians at the Queen Elizabeth Central Hospital and representatives from the Ministry of Health. The tools include general CPAP training materials and a competency test to evaluate the skills of the mentees before and after mentorship. Only five of the seven mentors were included in this analysis, as the other two mentored sites provided incomplete mentorship evaluation data.

The implementation team identified sites that needed mentorship during quarterly monitoring visits and data reviews. The indications for mentorship were the poor identification of patients eligible for CPAP, low CPAP usage despite evidence of eligible beneficiaries and poor management and outcomes of patients placed on CPAP. These gaps were often the result of frequent staff rotations, which left nursery wards with staff who were not sufficiently knowledgeable or confident enough to use CPAP effectively. Once these challenges had been identified, a nurse mentor was dispatched to the selected site to conduct a 1-week mentorship programme for staff directly involved in the care of neonates.

Mentors used an assessment checklist that comprised five skill categories (Table 1) to assess CPAP competency immediately before and right after mentorship. Competency was assessed by asking individual mentees to demonstrate each skill and recording yes or no on the checklist. The checklist also allowed mentors to identify specific target areas that needed to be emphasised during mentorship, as well as observations on the general attitude and performance of each mentee. Mentees also filled out a self-evaluation checklist to provide feedback on their mentorship experiences and how much they felt they had learnt.

Once they had completed their mentorship at the hospital, the mentor gave feedback to the hospital management and shared a summary report of their mentorship experience with appropriate stakeholders. Mentors were compensated for their travel expenses, but mentees did not receive financial compensation as the training was carried out during their regular on-duty hours.

2.2 | Analysis of mentee knowledge and skills

Out of the 15 secondary- and tertiary-level facilities that received mentorship, 11 had complete mentorship checklist data available to qualify for inclusion in this analysis: 10 were secondary-level hospitals, and one was a tertiary-level hospital. To analyse the evaluation checklists, yes or no answers were given a score of one if the mentee successfully demonstrated the skill and a zero if they had not. The scores were added together, and the percentage of skills mastered was calculated. Changes in competency scores before and after mentorship were evaluated by hospital and skill categories.

2.3 | Qualitative analysis

The assessment checklist forms used by mentors contained sections for comments and a summary report. Information from these

TABLE 1 Skills evaluated by the CPAP competency test before and after mentorship

Skill category	Competency test components (one point each)
Mechanical	Recognise external parts/components of CPAP system Recognise external parts of the oxygen concentrator Set up the CPAP for use Test if the CPAP system is working Identify reasons why the system might not work
Setup	Demonstrate how to manage baby before CPAP Demonstrate how to monitor baby before CPAP Select appropriate size caps and prongs Select appropriate initial settings: oxygen, pressure and airflow Attach CPAP tubing to baby
Monitoring	Demonstrate how to check that the CPAP machine is working Demonstrate what to do if water is not bubbling Demonstrate how to monitor equipment Demonstrate how to monitor baby when they are on CPAP Demonstrate how to use saline drops and suction machine Demonstrate when and how to adjust oxygen and pressure flow settings Record data in the data collection form
Weaning	Demonstrate how to reduce CPAP settings Demonstrate how and when to take baby off CPAP Demonstrate how to monitor baby after weaning from CPAP
RDS Management	Demonstrate how to recognise severe respiratory distress Demonstrate how to manage babies with respiratory distress Demonstrate proper disinfection and infection prevention practices

comments and reports was qualitatively analysed to describe strengths, challenges and recommendations for the mentorship programme. Mentee self-evaluation checklists were also coded under strengths, challenges and recommendations.

2.4 | Analysis of CPAP outcomes and usage

De-identified CPAP usage and outcome data for the 11 hospitals included in this analysis were collected from a standard Ministry of Health Acute Respiratory Illness form used in all government hospitals in Malawi. To quantify CPAP usage and outcomes for the 3 months before and after mentorship, data were analysed for neonates with an admission weight of less than 2500 g with a final diagnosis of respiratory distress syndrome (RDS), as these neonates should benefit most from CPAP treatment.[4] At each facility, the number of neonates potentially eligible for CPAP was estimated as 30% of the number of preterm births recorded at the facility. The total monthly number of premature births was provided by the health management information system at each hospital. Estimates for the expected proportion of premature babies with RDS were derived from studies in similar settings,[11-14] and a conservative assumption of 30% of all premature infants born before and after the mentorship was used to estimate the number of eligible CPAP candidates. This number was compared with the actual number of patients receiving CPAP treatment during those periods, as documented on the Acute Respiratory Illness forms. The fraction of neonates treated with CPAP who survived to discharge was compared before and after mentorship. Fisher's exact test was used to assess whether the changes in CPAP usage and outcomes before and after mentorships were statistically significant.

2.5 | Ethics statement

The Ministry of Health gave permission for Rice University to use existing, de-identified secondary assessment data to evaluate mentee knowledge and skills before and after mentorship. As this was existing, de-identified data, it did not need to be reviewed by Rice University's Institutional Review Board.

To assess survival rates for neonates treated with CPAP, de-identified patient information was collected as part of a quality improvement study approved by the National Health Sciences Research Committee of Malawi (NHSRC #1180) and the Institutional Review Board of Rice University (13-102X).

3 | RESULTS

The five mentors visited the 11 sites included in this analysis: one of the mentors visited four sites, one visited three sites, one visited two sites and two visited one site each. An average of 10 mentees per site (range 5-14) benefited from the 1-week mentorship programme.

3.1 | Impact on staff knowledge and skills

A total of 113 mentees participated across the 11 hospitals that provided complete mentorship evaluation data. The average competency score before mentoring was 32 ± 4% and this increased to 97 ± 2% after mentorship (Figure 1). The average pre-mentorship scores for each of the five skill categories ranged from 26% to 66%, while the post-mentorship scores were 96% or above across all five categories (Figure 2).

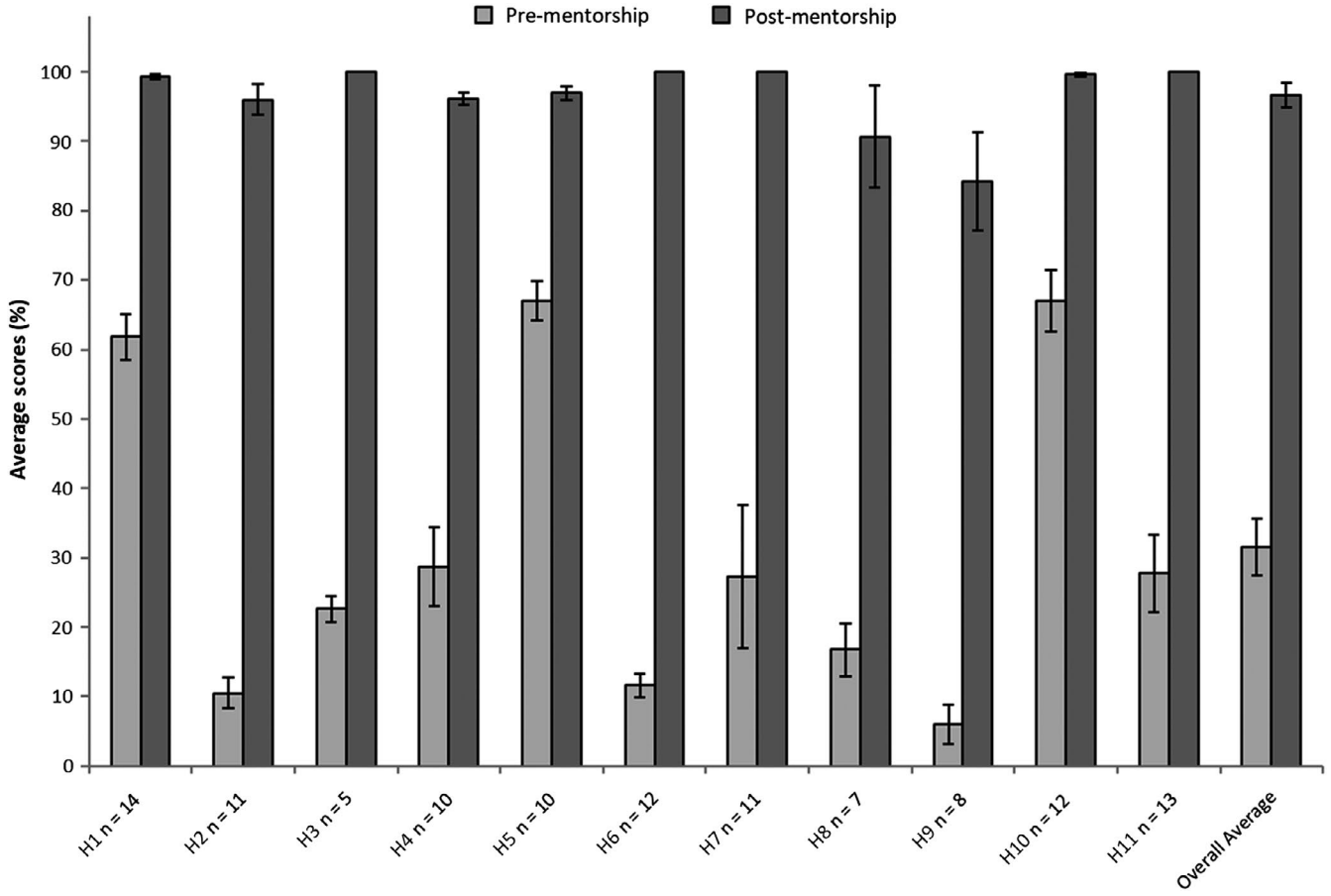

FIGURE 1 Average mentee scores for the CPAP competency test for each hospital before and after mentorship. 'n' represents the number of mentees evaluated. The last bar shows the overall average for the 113 mentees

3.2 | Usage and survival

At the 11 hospitals that provided complete mentorship data, 15 of the 213 CPAP-eligible patients were treated with CPAP during the 3-month period before mentorship, while 46 of 197 eligible patients were treated with CPAP in the 3 months following mentorship (Figure 3). This represented a significant increase in CPAP usage (7% vs 23%, $P < .001$). In these facilities, two neonates treated with CPAP were transferred to other hospitals, one before and one after the training programme and three neonates were removed from hospitals against medical advice: one pre-mentorship and two post-mentorship. The survival of the remaining eligible neonates treated with CPAP increased from 23% pre-mentorship to 35% post-mentorship (Figure 4). This improvement was not significant, possibly due to the small sample size.

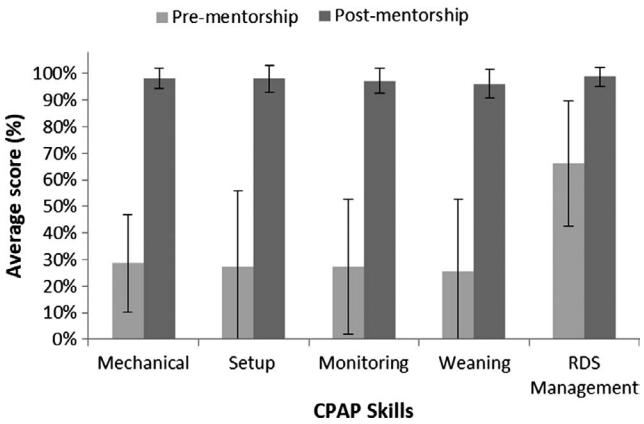

FIGURE 2 Average scores across all hospitals for the competency test, before and after mentorship, by skill category

3.3 | Reported benefits and challenges

Qualitative feedback from mentors and mentees highlighted the need for mentorship and support. The targeted mentorship reminded previously trained mentees of essential CPAP skills they had forgotten over time and boosted their confidence to apply those skills. Moreover, mentors noted that they were able to successfully impart new knowledge and skills to mentees who had never received prior training in CPAP.

Both mentors and mentees frequently reported that the time allocated for mentorship was too short, especially among mentees who had received no prior training in CPAP. Mentors sometimes found it difficult to fully conduct CPAP mentorship due to frequent power outages. In addition, the low volumes of eligible patients at some sites during the week-long mentorship period meant that mentees did not get enough practice time. Getting nurses to allocate

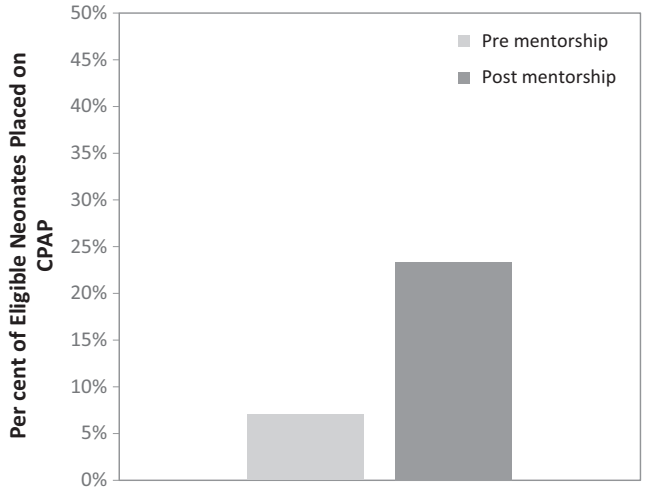

FIGURE 3 Percentage of eligible neonates placed on CPAP during the 3-mo periods immediately before and after mentorship ($P < .001$)

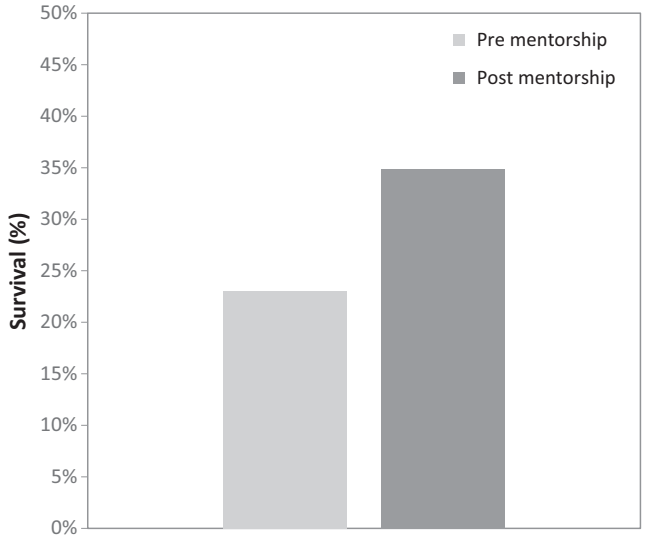

FIGURE 4 Percentage survival for the 3-mo periods immediately before and after mentorship for neonates with RDS weighing less than 2500 g

sufficient time to attend the mentorship sessions was difficult, because wards were often understaffed and the staff who were available had other responsibilities.

3.4 | Mentor and mentee recommendations

Mentors and mentees expressed the need for further periodic follow-up to monitor progress and assist with any ongoing problems. Mentors suggested that ongoing mentorship could be an interim solution to the high staff turnover, which was often due to rotations within facilities, to ensure that any newly assigned staff were familiar with CPAP use. They also encouraged internal mentorship between previously trained and mentored staff and those who were not.

Mentors sometimes went beyond the scope of the mentorship to help improve overall ward conditions. Together with the ward staff, they reviewed and improved the physical layout of the ward, infection prevention practices and traffic control within the ward.

4 | DISCUSSION

Our pre-mentorship assessments showed that the previous adopted system of providing a 1-day classroom-based CPAP training programme was inadequate, as it did not ensure that medical staff were able to implement the therapy effectively. During these assessments, mentors observed difficulties in various aspects of CPAP usage, even among previously trained health workers. These included preparing the CPAP machine for use, monitoring, weaning and troubleshooting problems.

In comparison with classroom-based forms of training, on-the-job instruction through mentorship provides an opportunity for healthcare staff to learn in their natural work environment, boosting their confidence and enabling them to apply what they have learnt. Following mentorship, CPAP was used to treat a greater proportion of eligible neonates and a greater proportion of neonates with RDS who were treated with CPAP survived following mentorship. Multiple factors are likely to have been involved in the increases in CPAP usage and neonatal survival. However, these results suggest that mentorships played an essential role in facilitating these improvements. Similar results have been seen in other studies that have observed survival rates following mentorships in hospital settings.[15]

Our findings were consistent with those of other training programmes focused on newborn health technology.[16] Even among previously trained staff, confidence and skill levels can be low, signalling the need for continuous in-service support. The mentorship sessions provided an opportunity for mentors to help improve their CPAP delivery and their general neonatal care. In Malawi, where the infrastructure and capacity to provide care neonates have been lacking, these interactions are important for strengthening the quality of neonatal care. By working with hospital administrators and staff to review ward policies, mentors play a key role of advocacy in this field.[6]

Despite the observation of system-level challenges, such as staff shortages, staff rotations and frequent power outages in a number of the mentored facilities, a growing body of work advocates that introducing CPAP as a form of therapy in such settings is both feasible and effective.[17,18] The staff in such facilities are often limited, and they need additional support to continuously refine their knowledge and skills against a background of given the system-level constraints.[18] Periodic mentorship has the ability to work around issues of staff rotations by ensuring that any knowledge and skills gaps among new staff are noted and addressed.[6] Bearing these challenges in mind during the design and implementation of mentorship programmes can improve the quality of neonatal care, even in secondary-level facilities, and reduce transfer rates to tertiary-level facilities.[17]

4.1 | Limitations of study

Although these preliminary results are encouraging, other studies have shown that mentors have a tendency to evaluate their mentees' positively.[6] This happened in our study, and it may have biased some of the assessment results. Mentees may also have positively evaluated their mentorship experiences in the same way, as the mentee evaluations were not anonymised. These limitations were accounted for in the decision to quantitatively assess CPAP usage and outcomes. In addition, the use of the dichotomous checklist for evaluating knowledge and skills did not allow participants to grade competency levels.

5 | CONCLUSION

Mentorship can build capacity in neonatal care by increasing staff confidence and bridging the knowledge and skill gaps caused by high staff turnover. Training programmes should consider embedding strategies that allow for frequent follow-up interactions between mentors and newly trained staff.

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CONFLICT OF INTEREST

Three of the authors, MO, RRK and EM, invented a patent for CPAP that has been licensed to 3SD at zero per cent royalties in countries eligible for GAVI, the vaccine alliance partnership. All royalties have been donated to Rice University to support global health research and education.

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